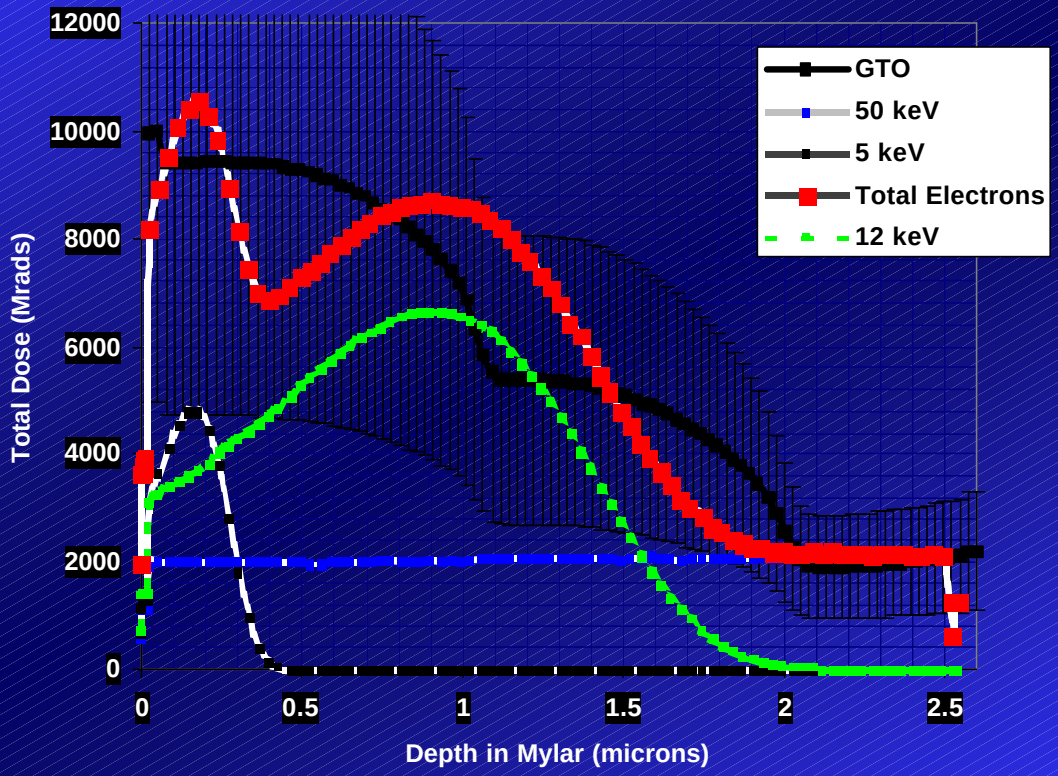
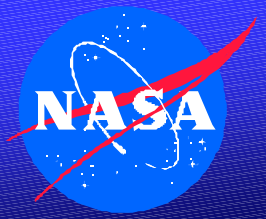
Dose – Depth Profile for Al/Mylar in GTO



April 3, 2001

National Aeronautics and Space Administration
George C. Marshall Space Flight Center

Materials, Processes and Manufacturing Department
Environmental Effects Group



Space Environmental Effects Testing and Characterization of Candidate Solar Sail Material Aluminized Mylar

David Edwards
Whitney Hubbs, George Wertz, and Richard Altstatt
NASA, MSFC

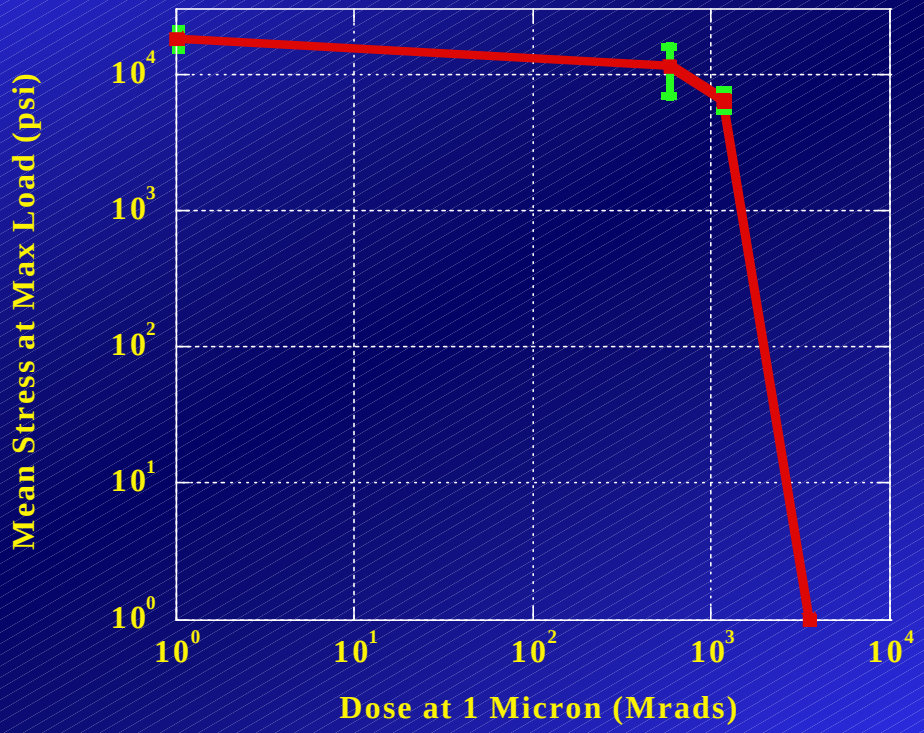
Work Funded by Randy Baggett/ASTP
Collaboration with Charles Garner / JPL

April 3, 2001

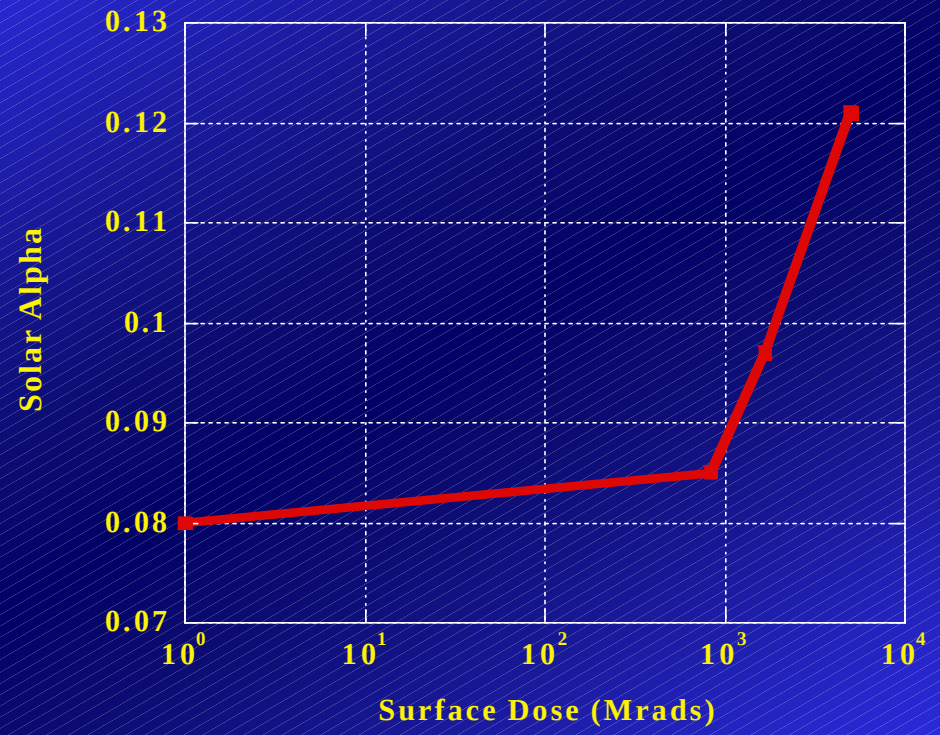
Outline

- Introduction
- Testing Facilities
- GTO Environment and Dose / Depth Profile
- Results
- Summary

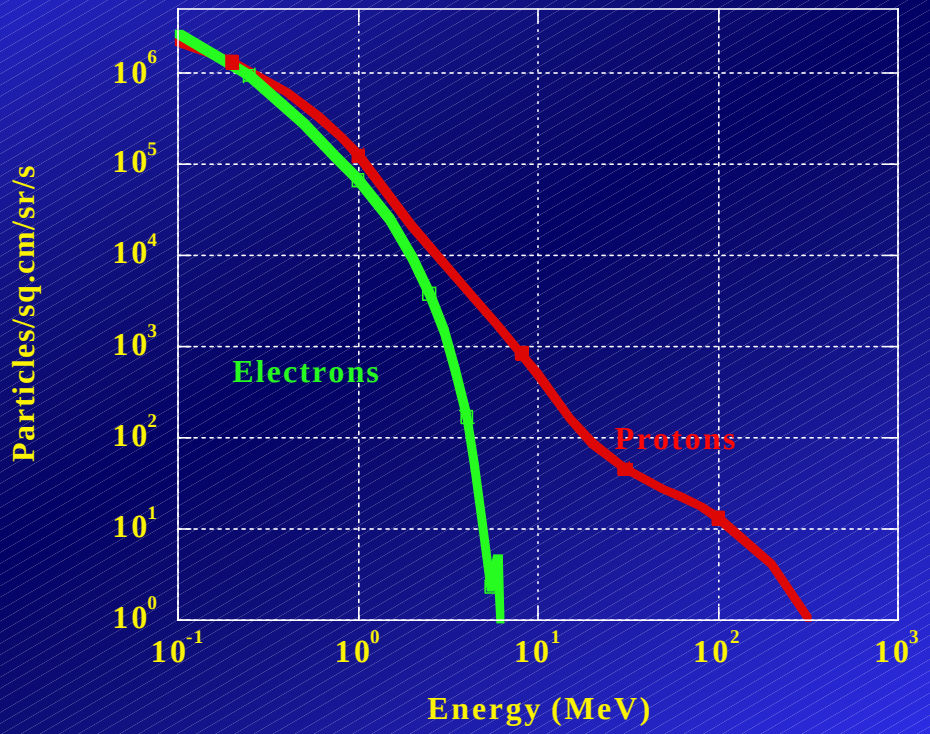
Mean Stress vs Dose in Mylar at 1 Micron



Solar Absorptance vs Surface Dose



GTO Spectrum of Protons and Electrons



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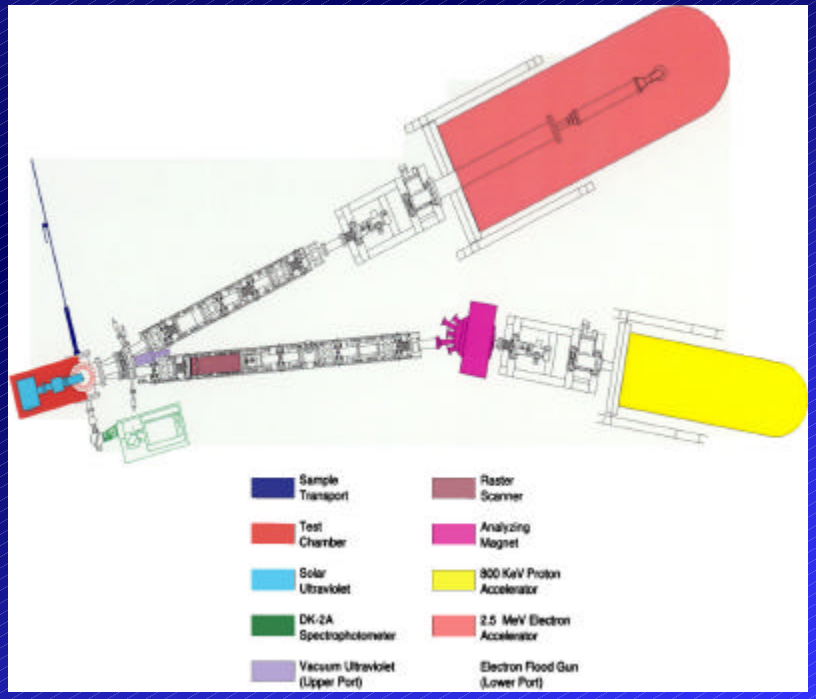
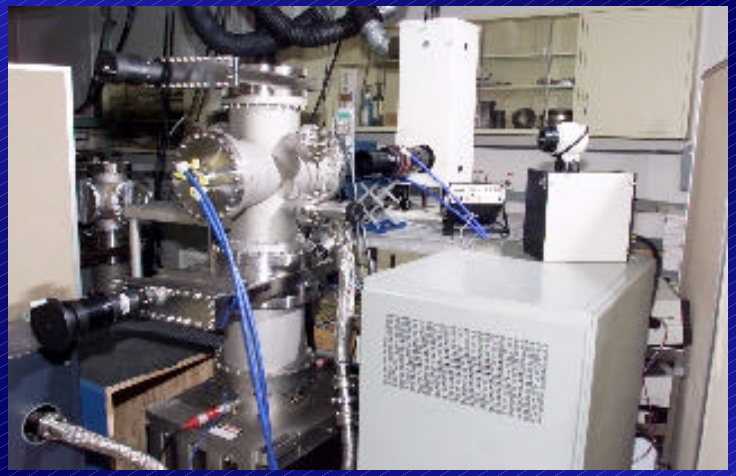
Testing Capabilities

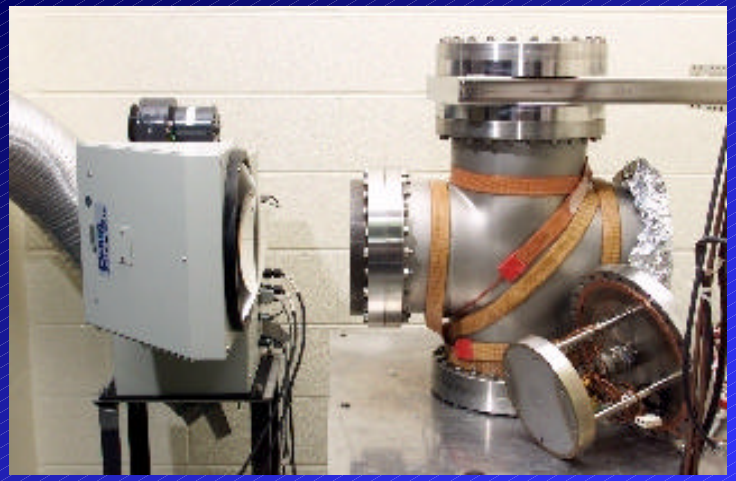
- One-of-a-kind Combined Environmental Effects Test System
  - Low Energy Electrons (1 keV - 50 keV)
  - High Energy Electrons (220 keV - 2.5 MeV)
  - Protons (30 keV - 800 keV)
  - NUV & VUV
  - In-Vacuum Reflectance Measurements



Testing Capabilities

- **Two (2) UV Test Systems**
  - **Water Cooled Sample Holder**
  - **17 cm Diameter Exposure Area**
  - **2-3 Suns Intensity**





Summary

- MSFC/ED31 has the Capability to Evaluate and Characterize Candidate Sail Materials in the Space Environment
- Absorbed Dose Values WILL be VERY LARGE
- Sail Stress Values need to be Calculated for Sail Missions
- Efforts in Sail Material Development Need to be Increased

Preliminary Equations Relating Tensile and Optical Properties to Absorbed Dose

- **Equation Relating Tensile Stress to Absorbed Dose**

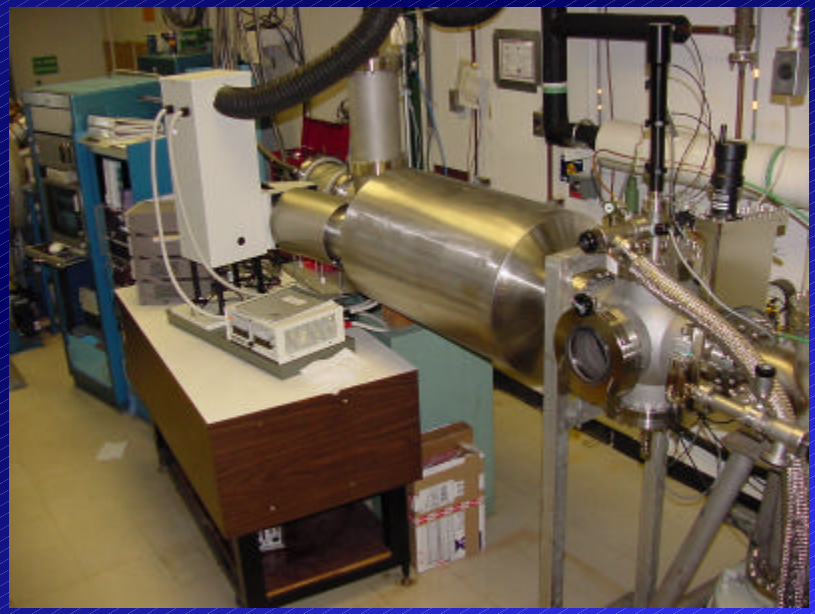
  - $Y = 18232 - 13.67X + 0.0034X^2 - 2.93 \times 10^{-7}X^3$
  - Y = Stress (psi) and X = Absorbed Dose (Mrads)

- **Equation Relating Solar Absorptance to Absorbed Dose**

  - $Y = 0.079 + 1.06 \times 10^{-5} X - 4.39 \times 10^{-10} X^2$
  - Y = Solar Absorptance and X = Absorbed Dose

Testing Capabilities

- **Low Energy Electrons**
  - ➢**1 KeV to 50 KeV**
- **NUV**
  - ➢**Enhanced NUV Source**
  - ➢**3 to 5 UV suns Intensity**
- **6 in. Diameter Exposure Area**
- **Base Vacuum 10^{-7} torr**



Testing Capabilities

- **Photon Momentum Measurement System**
  - **In-Vacuum Measurement**
  - **Sensitive to $1x10^{-8}$ N**
  - **Resolution of 0.01 Micro N**
- **4.75 in. Diameter Area**
- **Base Vacuum 10^{-7} torr**